EUROPEAN IMMIGRATION AND FOOD INSECURITY: RELEVANCE OF LESSONS LEARNED FROM AGROFORESTRY

Toth GG[1]*, Nair PK[1], Reynolds T[1]

*Corresponding author: gtoth@ufl.edu

(1) School of Forest Resources and Conservation, IFAS, University of Florida, Gainesville, Florida, USA

Introduction

More than a million migrants and refugees crossed into Europe in 2015 and hundreds of thousands more immigrated within Europe (Eurostat 2016). While these figures are driven by a myriad of reasons, many are fleeing food insecurity only to end up in situations where they still lack physical and economic access to sufficient, safe, and nutritious food that meets dietary needs and preferences for an active and healthy life (FAO 1996). As these populations settle into the rural, peri-urban, and urban areas that will become their homes there is potential for the latter two areas to solidify into so-called "Food Deserts." These are areas with "poor access to healthy and affordable food which may contribute to social and spatial disparities in diet and diet-related health outcomes" (Beaulac et al. 2009). As the definition implies, these areas are disproportionately more likely to be located in low-income, predominately minority neighborhoods (Raja et al. 2008). This paper focuses on the problems of food insecurity and potential food deserts for recent immigrants settling in urban and peri-urban environments throughout Europe. Specifically, it examines how food insecurity (and to a lesser degree some of its drivers) can be addressed through the lessons learned from the dynamics of agroforestry adoption. The authors suggest borrowing tools used in institutional analysis centered on agroforestry adoption in order to measure the potential sustainability of newly forming or transplanted communities and matching these with GIS mapping of existing Food System Pathways (FSP) in order to identify targets for food distribution and agroforestry technology extension improvements. The goals of this process are to: prioritize targets of rural sustainability and peri-urban production efforts and strengthen logistical connections between these areas and urban centers. To this end, we will first explain how potential sustainability can be measured using agroforestry adoption study methodologies. Next, using Nairobi as an example, we will show how GIS mapping has been used in other contexts to identify food deserts and FSP crossing the rural / urban divide. And finally we will note how agroforestry technologies have been shown to sustainably address food insecurity while helping to reduce climate change.

Methods

Sociological Context of Sustainability Measurement - Despite numerous efforts over the years to measure and integrate the ecological, economic, and social aspects of sustainability, a set of universally acceptable standards for measuring sustainability does not exist. Agroforestry systems (AFSs) are considered paradigms of sustainability, and in that sense can be used as general markers of sustainability for a community. Moreover the science of agroforestry has developed measures of sustainability for various components of AFS, but even these are faced with difficulties when it comes to holistic quantification and comparison. In ecological terms, the best criteria and indicators of AFS sustainability are ecosystem services. In terms of economic sustainability, the principles and procedures of ecological economics and valuation of ecosystem services are useful approaches. While both ecological and economic factors influence perceptions of agroforestry systems, benefits from neither of these realms can be realized without some level of adoption, a decision based primarily in the sociological sphere (Nair and Toth 2016). Measurement of social sustainability, perhaps more challenging than measurement of the ecological and economic components, entails assessment of such social factors as policy, culture, and other socioeconomic indicators (i.e. the institutional environment). Policy is the best entry point for stimulating change in an institutional environment (Place et al. 2012). Given that policy's influence resonates through the casual chain that affects the use of sustainable agriculture, it can be utilized as an acceptable indicator of the potential for such use in a given community. This is because smallholder farmers view the influential factors of sustainable agriculture through the lens of an institutional environment, which policy helps to shape.

Applying this approach relies on an understanding of the connections between previous policy implementations and sustainability outcomes. This understanding can then be compared with results of technology-adoption surveys and the functionality of schemes meant to incentivize use of sustainable-agriculture, such as Payments for Ecosystem Services. A general sense of potential for sustainability can be gained if, in addition to policy, the cultural and socioeconomic elements described below are investigated properly, allowing for a summation of the manner in which drivers of sustainable agriculture are perceived by a community (**Table 1**). Investigations of this nature are carried out through surveys, the results of which can then be calibrated against the results of biophysical-sustainability measurements in order to refine the process and produce a set of acceptable parameters. Identifying institutional factors is not difficult. Culture, and the social guidelines that define it, are easily ascertainable and for the most part well-defined for the majority of societies. Likewise, determining a particular household's socioeconomic status relies on indicators such as income, assets, and political position that require only cursory investigation. Moreover, even if policy is not clearly defined in writing, it can be identified through the rules it shapes and their effects. The difficulty lies in determining how these factors interact with one another to influence the adoption of agroforestry and thus the environmental sustainability of an agricultural setting. And this makes survey design and verification extremely important. Repetition has helped hone the quantification of these factors, and most agroforestry-adoption surveys today contain many of the same primary measures. Unfortunately, given the networked nature of these influences, it is inappropriate to use them individually for sustainability-assessment purposes. The existence of one factor (such as policy alone) may be ineffectual without the contributions of the other factors. Appraisals must be done holistically.

Table 1: Summary of measures for estimating adoption potential of agroforestry systems (Nair and Toth 2016)

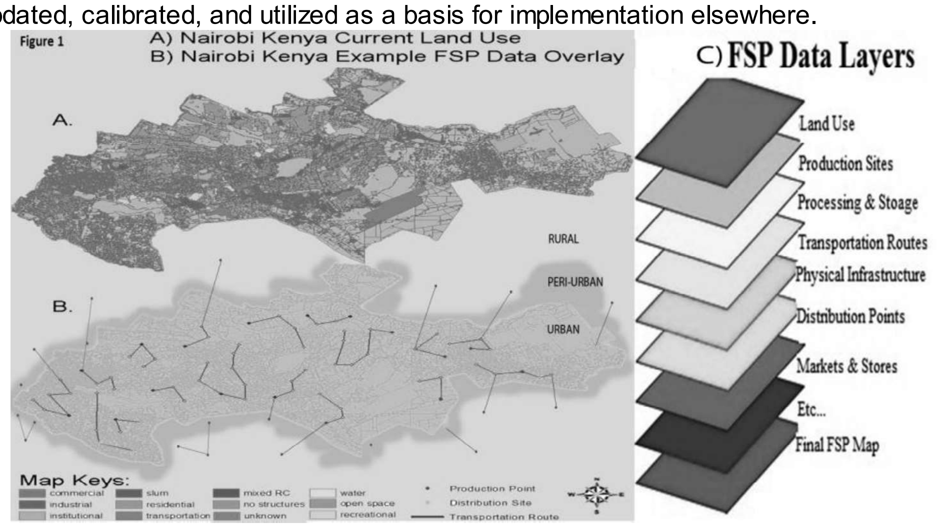
Inst. Env.	Parameter	Influence on sustainability	Measure/applicable	R
Policy	Subsidies	Technology dependent, can be positive or negative	Typically not represented by stated policies but by perceptions (good b/c disconnect is common). Often quantified on a Likert scale using ordinal measures.	11
	Property rights	Direct positive relationship		1
	Markets	Policies increasing access create demand upturn		3
	Infrastructure	Schools, medical, roads, etc., increase adoption		2
	Extension	Teaching and supporting tech use has positive effect		9
	Tech available	Direct positive relationship		5
	Awareness	Direct positive relationship		2
Socio-economic factors	Access	Type of input can have positive/negative effect	Typically concrete, i.e., not perception. Often quantified through continuous measures denotable in intervals. This is good b/c it can highlight differences in population outcomes.	13
	Property size	Often tied to soil quality; positive relationship		13
	Land tenure	Direct positive relationship		7
	Income/wealth	Direction of relationship dependent on other factors		15
	Education	Mixed; predominately positive esp. w/ awareness		7
	Age	Inverse relationship		11
	Status	Mixes w/ factors like subsidy creating positive effect		2
Culture	Wealth meaning	If necessities met, value of gain often still positive	No "typical" method. Abstract so difficult to quantify but has real effects. Responses can be through ordinal or interval measurement, making comparison across studies difficult.	6
	Household roles	Stronger correlation with female household heads		12
	Communication	Direct positive relationship		8
	Marital residency	If manager / owner same influence is positive		12
	Family size	Often measure of available labor, positive relation		4
	Risk tolerance	Direct positive relationship		10
	Norm plasticity	Depends on other factors (e.g., policy)		14

Mapping Food Pathways and Food Insecurity - GIS allows for the integration of multiple data sources, representation of geographic data in map form, and the application of various spatial analytic techniques for proximity analysis (Chakraborty and Maantay 2011). Researchers have begun to use GIS techniques to model food insecurity in developing regions (e.g. Liu et al. 2008). The bulk of this research has focused on macro-level trends and only sparingly applied at the local level (e.g. city, community, neighborhood, household) due to issues of cost and expertise. The lack of data at this level makes large-scale models insufficient for use by local planners and administrators tasked with making decisions regarding the allocation of scarce resources. Efforts are under way to create high-quality, public-access shapefile layers for a number of major developing cities. For example, the Center for Sustainable Urban Development at Columbia University has completed extensive mapping of Nairobi, Kenya, including land use, roads and transportation, and building density (CSUD, 2014). These data represent a solid starting point for building a universal FSP geodatabase. Additional layers must be developed for each segment of the local food system (e.g. farms and production sites, processing and storage facilities, transportation routes, and distribution points; **Fig. 1C**) in order to illustrate FSP impediments and predict future hotspots for food insecurity. New FSP data for these layers can be collected using primary sources (e.g. direct observation via global positioning system) or secondary sources (e.g. remote sensing, aerial photography) where possible to reduce costs. Newly acquired data can be easily imported into the GIS system as a GPS eXchange Format (GPX) file, and automatically transformed into a shapefile layer using ArcGIS explorer tool (in ArcGIS 10.2) or equivalent, producing x,y map coordinates for each pertinent feature along with associated attribute tables. Once the entire dataset is accumulated into the geodatabase, FSP impediments can be mapped spatially to provide graphical evidence of location-specific food insecurity.

Agroforestry and Food Insecurity - Agroforestry's ability to address food insecurity and climate change are well documented (e.g. Jat et al. 2016, FAO 2013, Jamnadass et al. 2013, Tscharntke et al. 2012, Lal et al. 2007, and Nair et al. 2004). Equally important to the alleviation of food deserts is agroforestry's ability to promote nutritional security through varietal increases resultant of: direct food, income, and fuelwood provision, as well as improvement in ecosystem health (Dawson et al. 2013). Many agroforestry technologies are relevant to rural communities, however, in peri-urban areas one agroforestry practice is particularly relevant: homegardens (integrated tree – crop – animal production systems, often in small parcels of land surrounding homesteads). Homegardens evolved over time under the influence of resource constraints including population pressure and consequent reduction in available land and capital. Hailed as the epitome of sustainability, these integrated systems have the potential to mitigate environmental problems while providing economic gains, as well as food and nutritional security to owners. Food production is the primary function of homegardens; shade-tolerant food crops that can be grown with relatively less care and attention are the dominant species (Kumar and Nair 2006).

Discussion

By overlaying FSP maps with data collected from sustainability assessments of newly forming communities, extension agents and policy makers can identify existing and potential areas of food insecurity and where homegardens or other agroforestry technologies should be prioritized (**Fig. 1A&B**). Aside from the direct benefits to rural producers (and the creation of pathways for their products) this could help alleviate demand on currently overburdened producers while increasing the availability of healthy organic food in urban and peri-urban areas. This occurs as the framework targets optimal locations for enactment of peri-urban and rural agroforestry efforts by not only showing potentially weak points in the value and provision chain but by identifying where extension efforts would have the greatest likelihood of impact and success. For example, a rural community with a high potential sustainability measurement that is reasonably distant from an existing FSP or an expanding peri-urban area not near an existing FSP would be excellent targets for agroforestry extension (specifically regarding homegardens in the case of the latter). Conversely this framework allows determination of actual (vs. theoretical) FSP impediments for long-term planning, enabling stakeholders to target geographic locations with the most serious FSP impediments (i.e. food deserts) to maximize the potential of agroforestry initiatives. And, an additional benefit is that, this system provides a natural platform for monitoring and evaluating programmatic success that can be easily updated, calibrated, and utilized as a basis for implementation elsewhere.



References:

Ajayi OC, Akinnifesi FK, Mullila-Mitti J, DeWolf JJ, Matakala PW, Kwesiga FR (2006) Adoption, profitability, impacts and scaling-up of agroforestry technologies in Southern African countries. ICRAF, Lilongwe

Ajayi OC, Place F (2012) Policy support for large-scale adoption of agroforestry practices: Experience from Africa and Asia. In: Nair PKR, Garrity D (eds) Agroforestry: The Future of Global Land Use. Advances in Agroforestry 9. Springer, Dordrecht, p 175–201. doi:10.1007/978-94-007-4676-3_12

Bannister ME, Nair PKR (2003) Agroforestry adoption in Haiti: The importance of household and farm characteristics. Agroforest Syst 57(2): 149–157. doi:10.1023/A:1023973623247

Beaulac J, Kristjansson E, Cummins S (2009) Systematic Review of Food Deserts, 1966-2007. Preventing Chronic Disease 6(3):1-10.

Blatner KA, Bonongwe CSL, Carroll MS (2000) Adopting agroforestry: Evidence from Central and Northern Malawi. J of Sustainability For 11(3): 41–69. doi:10.1300/J091v11n03_03

Bromley DW (1991) Environment and economy: Property rights and public policy. Blackwell, Oxford

CSUD (Center for Sustainable Urban Development) (2014) Nairobi GIS Maps, Retrieved from: http://csud.ei.columbia.edu/projects/nairobi-regional-project/nairobi-gis-maps/.

Chakraborty J, Maanay JA (2011) Geospatial Analysis of Environmental Health. Springer, New York

Dawson IK, Place F, Torquebiau E, Malézieux E, Iiyama M, Sileshi GW, Kehlenbeck K, Masters E, McMullin S, Jamnadass R (2013) Agroforestry, food and nutritional security; Background paper for the International Conference on Forests for Food Security and Nutrition, FAO, Rome, 13–15 May, 2013

ESRI (1998) Environmental Systems Research Institute: http://www.esri.com/.

Eurostat (2016). Immigration. Retrieved from: http://ec.europa.eu/eurostat/web/products-datasets/-/tps00176. Retrieved on 4/1 2016.

FAO (1996) Rome Declaration on World Food Security. FAO, Rome, Nov. 1996 http://www.fao.org/docrep/003/w3613e/w3613e00.HTM

FAO (2013) Agroforestry, food security and climate change. Summary of Learning Event. Community for Climate Change Mitigation in Agriculture. FAO, Rome, March 2013 www.fao.org/climatechange/micca/75369

Fernandez R, Fogli A (2005) Culture: An empirical investigation of beliefs, work, and fertility. Am Econ J: Macroeconomics 1(1): 146–177. doi:10.1257/mac.1.1.146

German G, Akinnifesi FK, Edriss AK, Sileshi GW, Masangano C, Ajayi OC (2009) Influences of property rights on farmers' willingness to plant indigenous fruit trees in Malawi and Zambia. Afr J Ag Res 4(5): 427–437.

Jamnadass R, Place F, Torquebiau E, Malézieux E, Iiyama M, Sileshi GW, Kehlenbeck K, Masters E, McMullin S, Weber JC, Dawson IK (2013). Agroforestry, food and nutritional security. ICRAF Working Paper No. 170. Nairobi, World Agroforestry Centre. http://dx.doi.org/10.5716/WP13054.pdf

Jat ML, Dagar JC, Sapkota TB, Singh Y, Govaerts B, Ridaura SL, Saharawat YS, Sharma RK, Tetarwal JP, Jat RK, Hobbs H, Stirling C (2016). Climate Change and Agriculture: Adaptation Strategies and Mitigation Opportunities for Food Security in South Asia and Latin America. Advances in Agronomy (Forthcoming 2016). http://dx.doi.org/10.1016/bs.agron.2015.12.005

Kairuki G, Place F (2005) Initiatives for rural development through collective action: The case of household participation in group activities in the highlands of Central Kenya. International Food Policy Research Institute, Washington, D.C.

Meijer SS, Catacutan D, Ajayi OC, Sileshi GW, Nieuwenhuis M (2014) The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. Inter J Ag Sustainability 13(1): 30–54. doi:10.1080/14735903.2014.912493

Mercer DE (2004) Adoption of agroforestry innovations in the tropics: A review. Agroforest Syst 61(1): 311–328. doi:10.1023/B:AGFO.0000029007.85754.70

Lal R, Follett RF, Stewart BA, Kimble JM (2007) Soil Carbon sequestration to mitigate climate change and advance food security. Soil Science 172 (12): 943-956. doi:10.1097/ss.0b013e31815cc498

Kumar BM, Nair PKR (2006) Tropical Homegardens. Springer, New York

Liu J, Fritz S, van Wesenbeeck CFA, Fuchs M, You L, Obersteiner M, Yang H (2008) Spatially explicit assessment of current & future hotspots of hunger in Sub-Saharan Africa in the context of global change. Global and Planetary Change 64(3): 222-235.

Nair PKR, Toth GG (2016) Measuring agricultural sustainability of agroforestry systems. In: Lal R, Singh BR, et al. (ed.) Climate change and multi-dimensional sustainability in African agriculture. Springer, Dordrecht, The Netherlands (in press).

Nair PKR, Allen SC, Bannister ME (2004) Agroforestry Today: An Analysis of the 750 Presentations to the 1st World Congress of Agroforestry. J of Forestry 103(8): 417-421.

Pattanayak SK, Mercer DE, Sills E, Yang JC (2002) Taking stock of agroforestry adoption studies. Agroforest Syst 57(3): 173–186.

Place F, Ajayi OC, Torquebiau E, Detlefsen G, Gauthier M, Buttoud G (2012) Improved policies for facilitating the adoption of agroforestry. In: Koanga ML (ed) Agroforestry for Biodiversity and Ecosystem Services: Science and Practice. InTech, Rijeka, p 113–128. doi:10.5772/34524

Raja S, Ma C, Yadav P (2008) Beyond food deserts measuring and mapping racial disparities in neighborhood food environments. Journal of Planning Education and Research 27(4): 469-482.

Sirrine D, Shennan C, Sirrine JR (2010) Comparing agroforestry systems' ex ante adoption potential and ex post adoption: On-farm participatory research from Southern Malawi. Agroforest Syst 79(2): 253–266. doi:10.1007/s10457-010-9304-0

Stern PC (2000) Toward a coherent theory of environmentally significant behavior. J Soc Issues 56(3): 407–424.

Thangata P, Alavapati JPR (2003) Agroforestry adoption in Southern Malawi: The case study of Gliricidia sepium and maize. Agric Syst 78(1): 57–71. doi:10.1016/S0308-521X(03)00032-5

Tscharntke T, Clough Y, Wanger TC, Jackson L, Motzke I, Perfecto I, Vandermeer J, Whitbread A (2012) Global food security, biodiversity conservation and the future of agricultural intensification. Biological Conservation 151(1): 53–59. doi:10.1016/j.biocon.2012.01.068